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## **Thermoplastic Resins used in Dentistry**

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Additional information is available at the end of the chapter

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### **Abstract**

Thermoplastic materials such as polyamides (nylon), acetal resins, epoxy resins, polystyrene, polycarbonate resins, polyurethane and acrylic thermoplastic resins were introduced in dentistry as an alternative to classic resins, which have major disadvantages such as the toxicity of the residual monomer, awkward wrapping system and difficult processing.

Indications for thermoplastic resins include partial dentures, preformed clasps, partial denture frameworks, temporary or provisional crowns and bridges, full dentures, orthodontic appliances, anti-snoring devices, different types of mouth guards and splints. Some flexible myofunctional therapy devices, used for orthodontic purposes, may also be made of thermoplastic silicone polycarbonate-urethane.

The main characteristics of thermoplastic resins used in dentistry are as follows: they are monomer free and consequently nontoxic and nonallergenic, they are injected by using special devices, they are biocompatible, they have enhanced esthetics and they are comfortable to wear.

**Keywords:** Thermoplastic resins, injection devices, metal-free removable partial dentures

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## **1. Introduction**

Continuous development and progress of polymer's industry with applications in general and dental medicine was of great importance for the health domain. Using various types of resins for restorations in the oral cavity is beneficial from childhood till geriatric period [1-4].

Thermopolymerizable acrylic resins were first used in dental technique in 1936, this being a great step forward. Acrylic resins are also known as polymethylmethacrylate or PMMA. These synthetically obtained materials can be modeled, packed or injected into molds during the plastic phase and become solid after chemical polymerization [5, 6]. Thermopolymerisable acrylic resins have many disadvantages as increased porosity, high water retention, volume variations and irritating effect due to the residual monomer, awkward wrapping system and difficult processing. Because of these, once polymers developed, alternative materials such as polyamides (nylon), acetal resins, epoxy resins, polystyrene, polycarbonate resins etc. [7-9] came on the market.

The main characteristics of the thermoplastic resins used in dentistry are as follows: they are monomer-free and consequently nontoxic and nonallergenic, they are injected by using special devices, they are biocompatible, they have enhanced esthetics and they are comfortable to wear [10].

2. Types of thermoplastic resins used in dentistry

The classification of resins according to DIN EN ISO 1567 is presented in Table 1:

| Type   | Class (manufacturing)              | Group (presentation form)                                                                |
|--------|------------------------------------|------------------------------------------------------------------------------------------|
| Type 1 | Thermopolymerizable resins (>65°C) | Group 1: bicomponent powder and liquid<br>Group 2: monocomponent                         |
| Type 2 | Autopolymerizable resins (<65°C)   | Group 1: bicomponent powder and liquid<br>Group 2: bicomponent powder and casting liquid |
| Type 3 | Thermoplastic resins               | Monocomponent system grains in cartridges                                                |
| Type 4 | Light-cured resins                 | Monocomponent system                                                                     |
| Type 5 | Microwave cured resins             | Bicomponent system                                                                       |

Table 1. The classification of resins according to DIN EN ISO 1567

Among the technologies for manufacturing removable complete and partial dentures we distinguish: heat-curing, self-curing, injection, light-curing, casting and microwave use [11].

Thermoplastic resins may be classified by their composition, as acetal resins, polycarbonate resins (belonging to the group of polyester resins), acrylic resins and polyamides (nylons).

The use of thermoplastic resins in dental medicine is continuously growing. The material is thermally plasticized and no chemical reaction takes place. The injection of plasticized resins into a mold represents a new technology in manufacturing complete and removable partial dentures [12].

At present, due to successive alterations in the chemical composition, thermoplastic materials are suitable for manufacturing removable partial dentures with no metallic components, resulting in the so-called “metal-free removable partial dentures” [13].

Indications for thermoplastic resins include removable partial dentures, preformed clasps [14], partial denture frameworks, temporary or provisional crowns and bridges, complete dentures, orthodontic appliances, anti-snoring devices, different types of mouth guards and splints. Some flexible myofunctional therapy devices, used for orthodontic purposes, may also be made of thermoplastic silicone polycarbonate-urethane.

### **2.1. Thermoplastic acetal**

Thermoplastic acetal is a poly(oxy-methylene)-based material, which as a homopolymer has good short-term mechanical properties but as a copolymer has better long-term stability [15]. Due to its resistance to wear and fracture, combined with a certain amount of flexibility, acetal resin is an ideal material for preformed clasps for partial dentures, single-pressed unilateral partial dentures, partial denture frameworks (Figure 1), provisional bridges, occlusal splints and implant abutments, artificial teeth for removable dentures and orthodontic appliances [16].

Because of their resistance to occlusal wear, acetal resins are also well suited for maintaining vertical dimension during provisional restorative therapy. Acetal is not translucent and does not match the esthetic appearance of thermoplastic acrylic and polycarbonate [17].



**Figure 1.** Removable partial denture with acetal frame and clasps

### **2.2. Thermoplastic polyamide (nylon)**

Thermoplastic polyamide (nylon) is a resin derived from diamine and dibasic acid monomers. Versatility is one of its characteristics and makes it suitable for various applications. Nylon

exhibits high flexibility, physical strength, heat and chemical resistance. It can be easily modified to increase stiffness and wear resistance. Because of its excellent balance of strength, ductility and heat resistance, nylon is an outstanding candidate for metal replacement applications [18]. Nylon is mainly used for tissue supported removable dentures. Its stiffness makes it unsuitable for usage as occlusal rests or denture elements that need to be rigid [7, 13]. Because it is flexible, it cannot maintain vertical dimension when used in direct occlusal forces. Adjustment and polishing is difficult but provides excellent esthetics due to its semitranslucency [19, 20].

Nylon is specially indicated for patients allergic to methyl metacrylate, being monomer-free, lightweight and impervious to oral fluids [21]. Some may also be combined with a metal framework (Figure 2).



**Figure 2.** Removable partial denture of polyamide combined with metal

Comparative properties of thermoplastic acetal and polyamide, the two types of resins suitable for manufacturing removable partial dentures, are shown in Table 2.

| Resin type       | Main substance | Resistance | Durity    | Flexibility         | Esthetics | Biocompatibility |
|------------------|----------------|------------|-----------|---------------------|-----------|------------------|
| Acetalic resin   | polioximetylen | very good  | very high | medium              | good      | very good        |
| Polyamidic resin | diamine        | good       | high      | medium or very high | very good | very good        |

**Table 2.** Comparative aspects of acetalic and polyamidic thermoplastic resins

**2.3. Thermoplastic polyester**

Thermoplastic polyester resins are also used in dentistry. They melt between 230°C and 290°C and the technology implies casting into molds. Polycarbonate resins are particularly polyester

materials. They have good fracture strength and flexibility, but the wear resistance is lower

### 2.3 Thermoplastic polyester

Polycarbonates have a natural translucency and finishes very well, which recommends them for temporary restorations, but they are not suitable for partial denture frameworks [22]. Thermoplastic polyester resins are also used in dentistry. They melt between 230°C and 290°C and the technology implies casting into molds. Polycarbonate resins are particularly polyester materials. They

have good fracture strength and flexibility, but the wear resistance is lower than acetal resins.

### 2.4 Thermoplastic acrylate

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Thermoplastic acrylate consists of fully polymerized acrylate, its base component being

### 2.4 Thermoplastic acrylate

methacrylate, the special blend of polymers giving it the highest impact rating of any acrylic. This material was developed for manufacturing complete dentures. It is not elastic, but Thermoplastic acrylate consists of fully polymerized acrylate, its base component being methyl-metacrylate, the special blend of polymers giving it the highest impact rating of any acrylic. This structure being dense and smooth. Due to the absence of residual monomer, its biocompatibility is practically unbreakable. The material has long-term adaptability because water retention is limited. You can bounce such denture off the floor without cracking the base [7,21,23].

### 2.5. Presentation form and injection

#### 2.5 Presentation form and injection

Thermoplastic materials can be polymerized or prepolymerized and they can be found in granular form, with low molecular weight, already wrapped in cartridges that eliminate dosage errors (Figure 3).

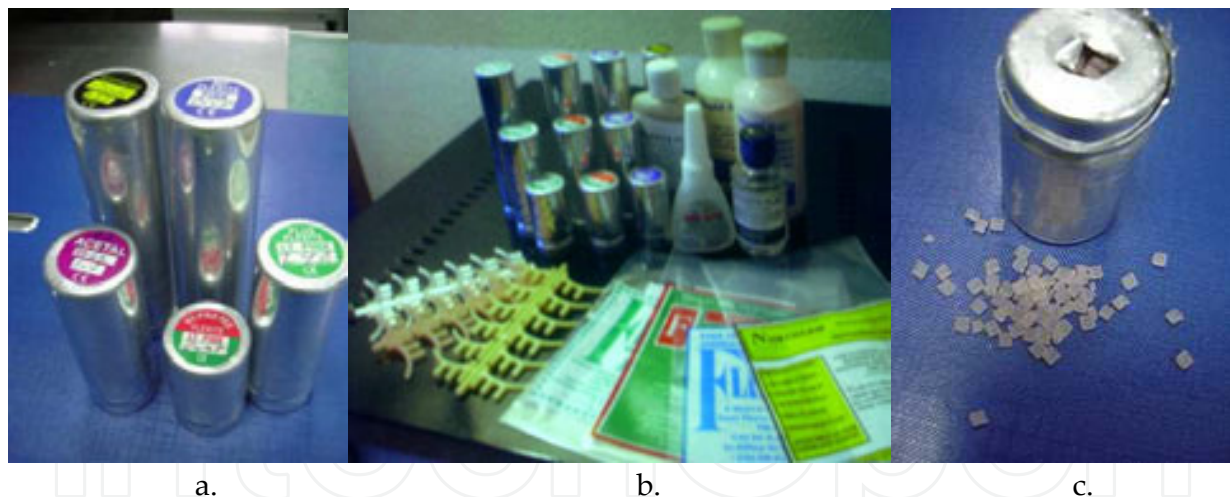


Figure 3. (a, b) Cartridges of different thermoplastic resins (c) The granular aspect of the material

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They exhibit a high rigidity despite their low molecular weight. Their plasticizing temperature is low (200°C-250°C). Thermal plasticization takes place in special devices, afterward the material is injected under pressure into a mold, without any chemical reactions. After heating, the metallic cartridges containing thermoplastic grains are set in place into the injecting unit and the plasticized resin is forced into the mold at a pressure of 6-8 bars. Pressure, temperature and injecting time are automatically controlled by the injecting unit. Dentures obtained using this technology have excellent esthetics and good compatibility [7, 12, 13, 22]. Injecting thermoplastic resins into molds is not a common technology in dental laboratories because the need of expensive equipment and this controlled by the injecting unit. Dentures obtained using this technology have excellent esthetics and good compatibility [7, 12, 13, 22]. The special injection devices we use are Polyapress (Bredent) and R-3C (Flexite) injectors (Figure 4).

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Figure 4

free and consequently nontoxic and nonallergenic, they are injected by using special devices, they are biocompatible, they have enhanced esthetics and they are comfortable to wear.

Our experience with thermoplastic resins for dental use involves solving several different cases of

partial edentations, with removable partial dentures without metallic framework, or combining the metallic framework with thermoplastic resin saddles, using different thermoplastic resins, selected according to their indications and manufacturing technology (Figure 5).

The main characteristics of thermoplastic resins used in dentistry are as follows: they are comfortable to wear, free and consequently nontoxic and nonallergenic, they are injected by using special devices, they are biocompatible, they have enhanced esthetics and they are comfortable to wear.

Our experience with thermoplastic resins for dental use involves solving several different cases of partial edentations, with removable partial dentures without metallic framework, or combining the metallic framework with thermoplastic resin saddles, using different thermoplastic resins, selected according to their indications and manufacturing technology (Figure 5).



Figure 5. Different combinations between thermoplastic resins, with or without metal [12]. Injection was carried out using the R-3C digital control device that has five preset programs, as well as programs that can be individually set by the user.

The types of thermoplastic resins we used for manufacturing different types of removable partial dentures are acetal resins and polyamides of different flexibilities.

### 3.1 Removable partial dentures with acetal framework

The acetal resin has optimal physical and chemical properties and it is indicated in making frameworks and clasps for removable partial dentures, being available in tooth color and pink [12]. Experimentally, in some cases, we combined an acetal resin frames with classic acrylic resins for the saddles (Figure 4). However, the resistance values for the acetal resin framework do not reach those of a metal one [16], consequently the main connector, the clasps and the spurs need to be oversized

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Figure 6. Acetal framework and clasp and removable partial dentures with acetal framework and clasps

The maintenance, support and stabilizing systems used are metal-free ones.

The significant aspects of the technical steps in the technology of removable partial dentures made of thermoplastic materials are described.

The master model is poured of class IV hard plaster using a vibrating table (Figure 7).



In order to assess its position, a parallelogram analysis is made (Figure 8). The abutment teeth are selected and the position of the cast is chosen and recorded so that a favorable path of insertion is obtained. To record the position of the cast tripod marks are used. The contour heights on the abutment teeth and the retentive muco-osseous tissues are marked. The abutments undercuts are measured and the engagement of the terminal third of the retentive arms of the clasps is established.

After the parallelogram analysis is carried out, the future frame design is drawn, including all extensions of saddles, major connector, retentive and bracing arms of the clasps, occlusal rests and minor connectors of Ackers circumferential clasps on abutment teeth. The design starts with the saddles, following the main connector, the retentive and opposing clasp arms, the spurs and the secondary connectors of the Ackers circular clasps [12, 13].

In order to assess its retentiveness and to determine the place where the active arms of the clasp are placed a parallelograph analysis is made (Figure 8). The abutment teeth are selected and the position of the cast is chosen and recorded so that a favorable path of insertion is obtained. To record the position of the cast tripod marks are used. The contour heights on the abutment teeth and the retentive muco-osseous tissues are marked. The abutments undercuts are measured and the engagement of the terminal third of the retentive arms of the clasps is established.

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After designing the framework, the master model is prepared for duplication, including foliation and deretentivisation (Figure 9). At the beginning, blue wax plates are used as spacers in regions where the framework has to be spaced from the gingival tissue. [12].

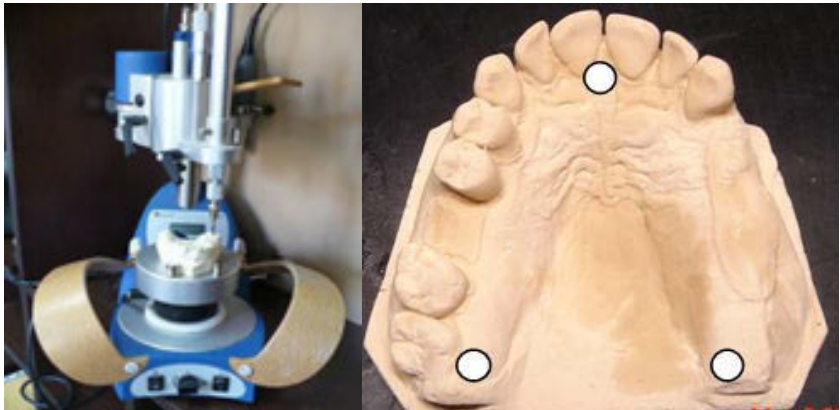


Figure 8. Parallelograph analysis



Block-out wax is applied between teeth cervices and gingival margin of the drawing representing the clasps arms. The block-out wax meets the spacing wax in a smooth joint.

Figure 9. Deretentivisation of the model

In order to duplicate the master model, a vinyl-polysiloxane silicone placed in a flask is used. After its setting, the duplicate model is poured (Figure 10), using class IV hard plaster.

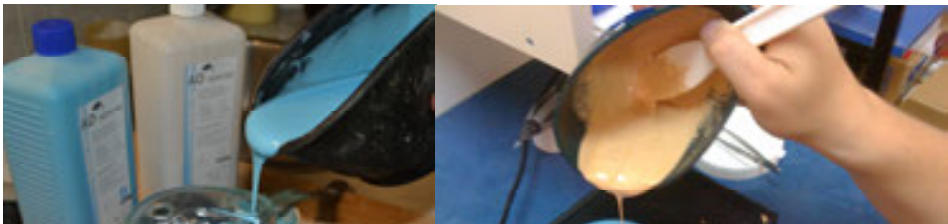




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Figure 10. (a) Duplication of the model (b) Casting of the duplicate model using class IV hard plaster

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The elements of removable partial denture's wax pattern are as follows (Figure 11a): the main connector, made of red wax (so that its thickness is twice as normal), the saddles and the Ackers circular clasps, made of blue wax. Injection bars are also required for those areas of the framework that are not visible in the finite piece. A large central shaft is necessary in order to connect with the main connector, through which the initial injection takes place. Unlike the pattern of a metallic framework, the patterns of the metal-free framework have to be 50% thicker (clasps, occlusal rests and main connector) [12, 13]. Spruing the framework is performed using minor sprues of 2.5 mm calibrated wax connected to one major sprue (Figure 11a). Spruing the framework is performed using minor sprues of 2.5 mm calibrated wax connected to one major sprue (Figure 11a).



Figure 11. (a) Wrapping the wax pattern frame of the removable partial denture (b) Insulation of the investment

Surface tension reducing solution is applied and the wax pattern is then invested in a vaseline insulated aluminum flask (Figure 11b). Class III hard stone is used as an investment. The gypsum paste is poured into one of the two halves of the flask and the duplicated model containing the framework pattern with sprues attached is centrally dipped base-face down. After setting, the gypsum surface is insulated and the second half of the flask is assembled. Class III hard stone is once more prepared and the flask is submerged in warm water in a thermostatic container. The two halves of the

Surface tension reducing solution is applied and the wax pattern is then invested in a vaseline insulated aluminum flask (Figure 11b). Class III hard stone is used as an investment. The gypsum paste is poured into one of the two halves of the flask and the duplicated model containing the framework pattern with sprues attached is centrally dipped base-face down. After setting, the gypsum surface is insulated and the second half of the flask is assembled. Class III hard stone is once more prepared and the flask is submerged in warm water in a thermostatic container. The two halves of the flask are disassembled and the wax is boiled out using clean hot water. The surface of the mold is then insulated and treated with a light-curing transparent varnish in order to obtain a shining aspect [12, 13].

Injection is carried out with the R-3C (Flexite) injector (Figure 4b), which does not take up much space as it can be mounted on a wall as well. The device has the following parameters: digital control, preset programs for different types of thermoplastic resins and programs that can be individually set by the user. The pressure developed is 6-8 Bar [23].



Figure 12. Schedule of “G” program of injecting the thermoplastic material (a) Start (b) Heating (c) Injecting (d) Cooling

Before investment removal, screws are loosened and the flask is gently disassembled (Figure 13). Before starting injection, the valves of carbon dioxide tank are checked to make sure the injecting pressure is according to procedure demands (7.2-7.5 Bar). Preheating temperature and time are also checked (15 minutes at 220°C). The selected cartridge (quantity and color) is



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cartridge is separated and the flask is then released and pulled out. In order to achieve optimal quality of the structure, the flask is released after injecting the thermoplastic material.

Before investment removal, screws are loosened and the flask is gently disassembled (Figure 13). Before investment removal, screws are loosened and the flask is gently disassembled (Figure 13).

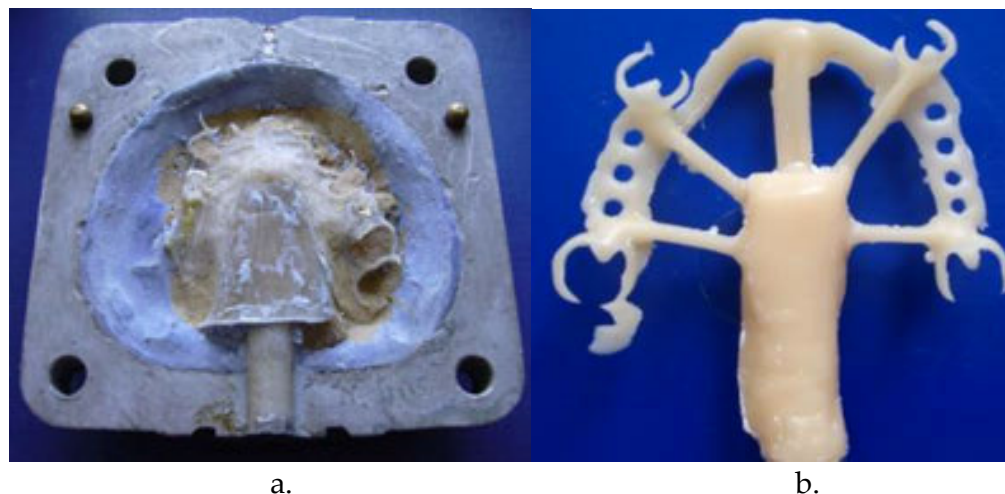


Figure 13. Disassembling the framework of the acetal resin removable partial denture (a) The framework is still in the flask (b) Disassembling is complete

The sprues are cut off using low-pressure carbide and diamond burs to avoid overheating the material. Finishing and polishing is performed using soft brushes, ragwheel and polishing paste (Figure 14).

Disassembling the framework of the future removable partial denture is followed by matching it to the model, processing and finishing this component of the removable partial denture (Figure 15).

Once the framework is ready, the artificial teeth are set up. Wax patterns of the saddles are constructed by dropping pink wax over the framework. Teeth set up starts with the most mesial tooth, which is polished until it esthetically fits onto the arch [24].

After properly setting of all the teeth are the wax pattern is invested in order to obtain the acrylic saddles. An impression of the wax pattern placed on the master model is made by using a putty condensation silicone.

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Figure 14. (a) Tools used for processing the acetal framework (b) Tools used for finishing and polishing the acetal framework (c) Special polishing paste

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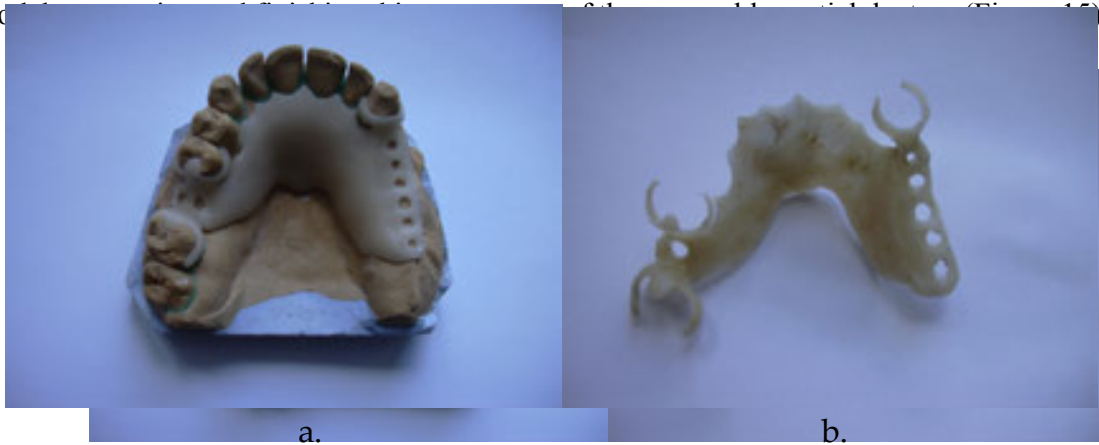


Figure 15. (a) Matching the acetal framework to the model (b) The finished acetal framework

Once the framework is ready, the artificial teeth are set up. Wax patterns of the saddles are constructed by dropping pink wax over the framework. Teeth set up starts with the most mesial tooth, which is polished until it esthetically fits onto the arch [24].

After properly setting of all the teeth are the wax pattern is invested in order to obtain the acrylic saddles. An impression of the wax pattern placed on the master model is made by using a putty/condensation silicone.

After setting, impression is detached, wax is removed, and the teeth, framework and the master model are thoroughly cleaned. Impression is being cut on the lateral sides of the impression and the teeth are set in the corresponding places inside the impression [13].

After simulating the master model, the self-curing acrylic resin is prepared and poured inside the impression through the lateral openings. The cast is introduced into a heat-pressure curing unit setting at a temperature of 50 °C and a pressure of 6 bars for 10 minutes to avoid bubble development. Once the resin is cured, the impression is removed [12, 13]. Burs, brushes, ragwheels and pumice are used to remove the excess, to polish and finish the removable partial denture (Figure 16b).



Figure 16. (a)

sin and acrylic

Self-curing acrylic resin is used for the denture base and the partial denture. The cast is introduced into a heat-pressure-curing unit setting a temperature of 50°C and a pressure of 6 bars for 10 minutes to avoid bubble development. Once the resin is cured, the impression is removed [12,13]. Burs, brushes, ragwheels and pumice are used to remove the excess, to polish and finish the removable partial denture (Figure 16b). The result is a consistent removable partial denture with no macroscopic deficiency even in the thinnest 0.3-0.5 mm areas of clasps, which means the technology is effective.

### 3.2 Removable partial dentures made of different types of polyamides

The result is a consistent removable partial denture with no macroscopic deficiency even in the thinnest 0.3-0.5 mm areas of clasps, which means the technology is effective. Making polyamide resin removable partial dentures does not require so many intermediary steps as those made of acetal resins. The steps are similar to those followed for acrylic dentures, but with thermoplastic materials the injecting procedure is used. The clasps are made of the same material as the denture base, when using superflexible polyamide or ready-made clasps, in the case of using medium-low flexibility polyamide [12] (Figure 17).

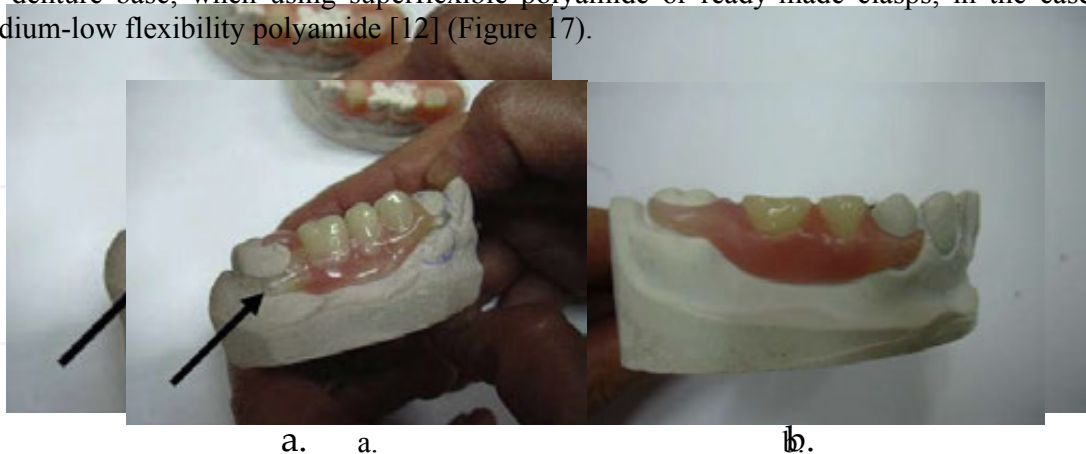


Figure 17. Polyamide removable partial denture with (a) pre-formed clasps (b) clasps made of the same material as the denture base

Using flexible polyamide is indicated in cases of retentive dental fields (Figure 18). Using flexible polyamide is indicated in cases of retentive dental fields (Figure 18).

When manufacturing polyamidic dentures, the support elements blend in with the rest of the denture, as they are made of the same material [25, 26].



the polyamides, nylon. These can be used for denture work, or in association with injectable resins. Another option we used is the resin.

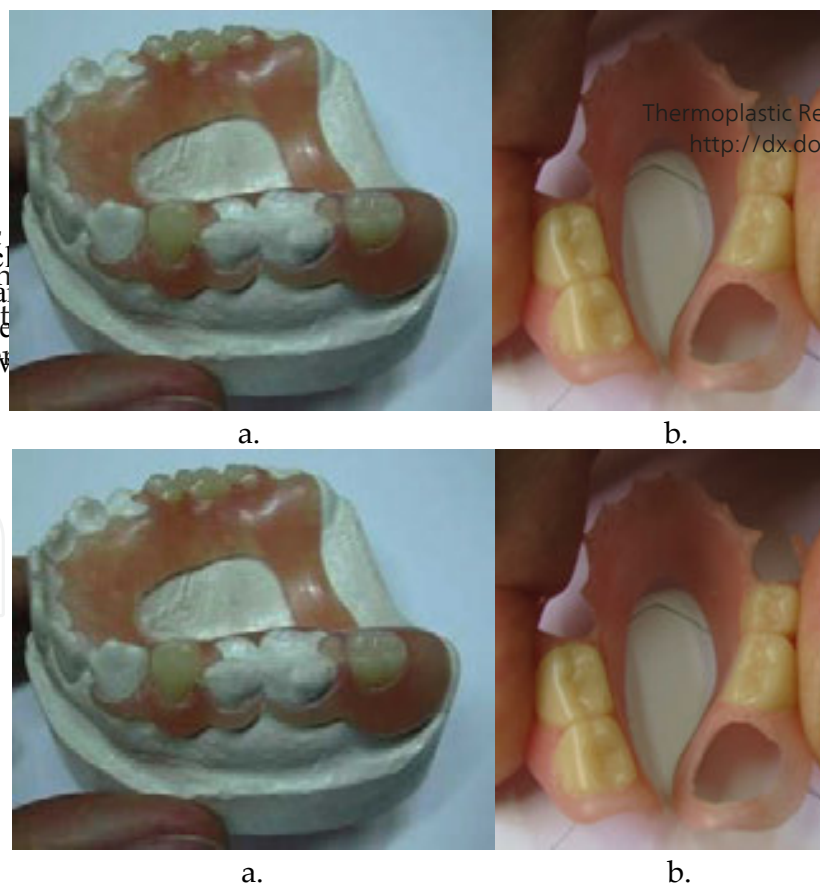


Figure 20. (a) Medium-low flexibility polyamide partial dentures (b) Superflexible polyamide partial dentures

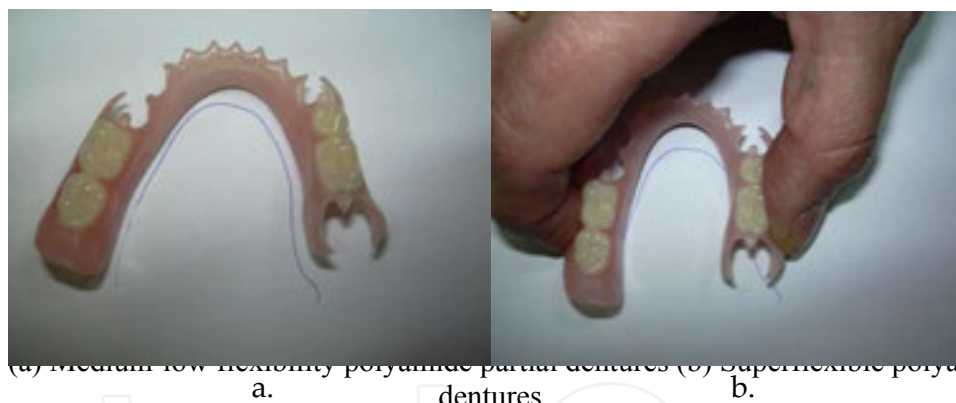


Figure 21. (a) The superflexible polyamide denture (b) The final flexibility test

### 3.3 Kemeny-type removable partial dentures made of acetal

#### 3.3. Kemeny-type removable partial dentures made of acetal

As an experiment, we managed partial reduced edentulous with acetal Kemeny-type dentures (Figures 22 and 23) as an alternative to fixed partial dentures, mainly in order to test the physiognomic aspect, having the advantage of a minimal loss of hard dental substance, located only at the level of the occlusal rims, in case of posterior teeth.

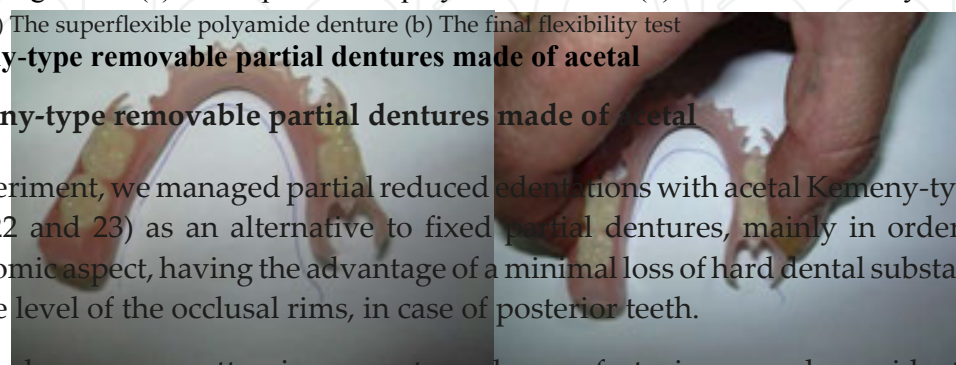


Figure 22 shows wax patterning aspects and manufacturing a molar unidental Kemeny denture of acetal resin, while Figure 23 shows the way in which a frontal bidental edentation can be managed. The effectiveness of the technology is ensured by making artificial teeth of the same material.

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Figure 22. Kemeny dentures: (a) Unimolar denture wax pattern (b) Denture made of acetal resin

Figure 22. Kemeny dentures: (a) Unimolar denture wax pattern (b) Denture made of acetal resin



### 3.4 Splints made of acetal resin

Thermoplastic resins are also indicated for manufacturing antisnoring devices, different types of mouthguards and splints. Parodontotic teeth after surgery need immobilization. We experimentally manufactured acetalic resin splints (Figure 24) which turned out to be a viable solution because it matches the color of the teeth and thereby represents a temporary postoperative esthetic choice [18,23].

### 3.5. Mouth guards

Mouth guards are dental appliances that can be manufactured using thermoplastic resins. The most satisfactory mouth protectors are custom-made mouth guards. This type of mouth guards is designed by the dentist. They adapt well and provide good retention and comfort. Being custom-made they interfere the least with speaking and have virtually no effect on breathing

Figure 24. Thermoplastic acetal splint

### 3.5. Mouth guards

Mouth guards are dental appliances that can be manufactured using thermoplastic resins. Mouth guards may be classified into two types: the vacuum mouth guard and the pressure-laminated mouth guard. The most satisfactory mouth protectors are custom-made mouth guards. This type of mouth guard is designed by the dentist. They adapt well and provide good retention and comfort. Being custom made

We manufactured laminated custom-made mouth guards for 3 layers, with the inner layer made of a thermoplastic polyurethane which increases discoloration resistance and creates a soft inner surface feel (Figure 25).



Figure 2

### 3.6 Multifunctional therapy devices

### 3.6. Myofunctional therapy devices

Controlling dentofacial growth interferences is an important issue. The negative effects of mouth breathing, abnormal lip and tongue function and incorrect swallowing patterns on craniofacial development in the mixed dentition period is well known. Correcting these myofunctional habits improves craniofacial growth and decreases the severity of malocclusion [12].

Myofunctional therapy retrains the muscles of swallowing, synchronizes the swallowing movements obtaining a normal resting posture of the tongue, lips, and jaw. Myofunctional therapy may be rescheduled before, during or after orthodontic treatment [30]. The most typical age range for this type of therapy is between 8 and 16 years.

The main objective of the myofunctional appliances is to eliminate oral dysfunction and to establish muscular balance. These appliances play a certain role in orthodontics because they are simple and economical. The selection of the cases needs to be thorough and the specialist needs to be well trained in their use.

The universal size products, suitable for children between 6 and 11 years old (mixed dentition stage), allow implementing the orthodontic treatment earlier and at lower cost. These are made of a flexible thermoplastic silicone polycarbonate-urethane, a ground-breaking copolymer that combines the biocompatibility and biostability of conventional silicone elastomers with the processability and toughness of thermoplastic polycarbonate-urethanes. This type of appliances has good in vitro and in vivo stability. Its strength is comparable to traditional polycarbonate-urethanes, and the biostability is due to the silicone soft segment and end groups. Various fabrication techniques may be used in order to obtain to different. Additional surface processing after fabrication is not needed [12].

## 4. Errors in manufacturing thermoplastic resins dentures

Errors might occur when manufacturing thermoplastic resins dentures: the insufficient pressure at injection, which leads to lack of substance, poor polishing, or too thick saddles being some of the causes (Figure 26). These errors lead to deficiencies of the denture, which might be unusable because of esthetic deficiencies, occlusal dysmorphia, exaggerated elasticity, and decubitus areas [31].

## 5. Conclusions

Thermoplastics used in dentistry have known a great diversification in the last years. Processing principles are similar to the injecting technology of chemoplastics, the main difference consisting in their chemical composition, liquefying temperature of grains, injecting pressure and the fact that thermoplastic resins are monocomponent.



usually needed as a support. Traditional metal-clasp retained stents are discarded in such cases as the clasps cause backscatter of the radiation beams. Acetal resin is a radiolucent material suitable for making a stent with clasps or even a removable partial denture to retain the bolus.

In the case of Kemeny-type acetalic dentures, the artificial teeth are made of the same material and in the same step as the rest of the denture. Because it is not translucent, its first indication is lateral edentations but it can be used for short periods, in the frontal area as well, if short-term esthetic aspect is not important.

Thermoplastic resins have several advantages: long-term performance, stability, resistance to deformation, resistance to wear, excellent tolerance, resistance to solvents, absence or low quantity of allergy-inducing residual monomer, and lack of porosity, thus preventing the development of microorganisms and deposits, all of which, together with maintaining size and color in time are very important characteristics, presenting a high degree of flexibility and resistance, permitting the addition of elastomers for increased elasticity or reinforcement with fiberglass, in order to increase their physical splinter quality; some of them can also be repaired or rebased.

The advantages of using the molding-injection system lay in the fact that the resin is delivered in a cartridge, thus excluding mixture errors with long-term shape stability, reduces contraction, and gives mechanical resistance to ageing.

As this class of materials, as well as the processing devices, has been continuously perfected, their future applicability in dental medicine will keep spreading.

Most probably, further chemical development of elastomeric and polymeric materials will enlarge the domain of clinical applications of thermoplastics in dentistry.

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